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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/790,212	03/02/2004	Junichi Tanaka	500.43597X00	1013

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EXAMINER	
KACKAR, RAM N	
ART UNIT	**PAPER NUMBER**
1763	

MAIL DATE	DELIVERY MODE
10/03/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/790,212	TANAKA ET AL.	
	Examiner	Art Unit	
	Ram N. Kackar	1763	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *16 August 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-6 and 10-25* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-6 and 10-25* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 18-25 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

In this instance the limitation "pre-measured amount of line edge corrugation extending along vertical mask sidewalls, as well as the amount of radicals and the amount of ions measured by said plasma monitor, wherein the line edge of the vertical mask sidewalls has corrugation consisting of alternating ridges and grooves, and wherein the amount of line edge corrugation is defined as a protrusion amount of ones of the ridges of the line edge divided by a protrusion width of the ones of the ridges of the line edge" is a new matter.

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 18-25 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In this instance the limitation "pre-measured amount of line edge corrugation extending along vertical mask sidewalls, as well as the amount of radicals and the amount of ions measured by said plasma monitor, wherein the line edge of the vertical mask sidewalls has corrugation consisting of alternating ridges and grooves, and wherein the amount of line edge corrugation is defined as a protrusion amount of ones of the ridges of the line edge divided by a protrusion width of the ones of the ridges of the line edge" is not only a new matter but is indefinite as not understood.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. **Claims 1-6 and 10-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kagoshima et al (US Pub 2003/0003607) in view of an Article " Modeling the impact of photoresist trim etch process on photoresist surface roughness" by Shahid Rauf et al.**

Kagoshima et al disclose an etching apparatus for etching of mask features (Fig 1 and Abstract) with plasma and a plasma monitor (3) which could be an optical emission spectroscope (OES) or quadrupole mass spectrometer (QMS) to monitor the species in the plasma (species of plasma contain ions and radicals which react with the substrate to do etching – Paragraph 27 and

44). Kagoshima teaches optimum recipe calculation model which depends upon the monitored result from the plasma monitor (24) and the measurement of CD (22).

Kagoshima et al fail to disclose the roughness parameter of the resist and its inclusion in the recipe calculation model.

Shahid Rauf et al have extensively studied dependence of etch rate upon roughness (undulation or corrugation) when all other factors remain same. They teach that the etch rate is high at the beginning if the initial roughness is high, and reduces when the roughness is reduced. So that it is essential to know the initial roughness in order to estimate etch time needed to etch to target CD. Shahid Rauf et al teach that the roughness factor (RF) is measured as in Fig 1 by R profile of the roughness part and the spatial frequency computed using Fourier transform (Page 656 Col 2). Since the roughness parameter is correlated to etch rate just like RF Power, gas flow, gas pressure and plasma density etc are correlated to it, its inclusion in the recipe calculation model would not only be obvious but essential. Further since etch rate is correlated to roughness and reduction of roughness is faster in the beginning of an etch (Fig 4) the time to etch to a target CD is affected by the initial roughness.

Therefore it would have been obvious for one of ordinary skill in the art at the time of invention to provide to the optimum recipe calculation model of Kagoshima et al, not only the monitored result of the plasma monitor and the measured CD, but the initial roughness (RF) of the mask in order to deal with the effect of roughness on recipe time.

Regarding 11, this is an intended use claim.

Regarding claim 12 the article's measure of roughness as special frequency and amplitude is correlated to aspect ratio.

Regarding claim 18 trimming condition calculating means is provided by the model, which includes the initial roughness parameter, which is calculated in the claimed way by Shahid Rauf et al.

Regarding claim 19, Shahid Rauf et al teach that due to roughness the protrusions (positive roughness) get etched faster compared to indentations (negative roughness) so that in the beginning etch process will mainly etch protrusions and roughness will reduce. Therefore total trim time will compose of roughness etch time and regular trim time.

Response to Arguments

Applicant's arguments filed 8/16/2007 have been fully considered but they are not persuasive.

Applicants argue that Shahid Rauf et al do not teach that it is essential to know the initial roughness in order to estimate etch time needed to etch to target CD.

In response it is stated that Shahid Rauf et al teach that (Page 657 Second paragraph and Fig 5) for the same etch time (25 second) the final rough ness is 60% if the initial roughness was 5nm compared to the case when it was 1nm. This means that if the initial roughness was large the reduction of roughness is faster. Same observation is available from Fig 4. Since to arrive at the target CD the first thing to be etched is the roughness, it is obvious that total time to etch to target will be affected by the initial roughness. (See the abstract also.)

It is noted that the same conclusion is disclosed in the specification as background information on the scientific nature of the process.

Applicant further argues that applicant's invention relates to only line edge roughness. However this is not supported by specification and is not part of the scope of the claims. Further, this issue has been addressed before.

Applicant's arguments against the references of Choo et al and Hays are not persuasive. However, since they are not part of the rejection no further discussion is needed at this time.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ram N. Kackar

whose telephone number is 571 272 1436. The examiner can normally be reached on M-F 8:00 A.M to 5:P.M.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on 571 272 1435. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Ram Kackar
Primary Examiner AU 1763